

LEWIS



## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON, D.C. 20546

REPLY TO  
ATTN OF:

GP

MAY 1 1974

TO: KSI/Scientific & Technical Information Division  
Attn: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General  
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,802,753

Government or : U.S. Government  
Corporate Employee

Supplementary Corporate :                       
Source (if applicable)

NASA Patent Case No. : LEW-11,087-3

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

YES ☐NO ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words "...with respect to an invention of ..."

*Bonnie L. Woerner*

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Enclosure

[54] HOLLOW ROLLING ELEMENT BEARINGS

[75] Inventor: Richard J. Parker, North Olmstead, Ohio

[73] Assignee: The United States of America as represented by the Administrator of the National Aeronautics and Space Administration, Washington, D.C.

[22] Filed: Mar. 30, 1973

[21] Appl. No.: 346,361

Related U.S. Application Data

[62] Division of Ser. No. 201,904, Nov. 24, 1971, Pat. No. 3,751,123.

[52] U.S. Cl. .... 308/188, 308/191

[51] Int. Cl. .... F16c 33/30, F16c 33/00

[58] Field of Search ..... 308/188, 215

[56] References Cited

UNITED STATES PATENTS

3,515,447 6/1970 Buzzard et al. .... 308/188

Primary Examiner—Charles J. Myhre

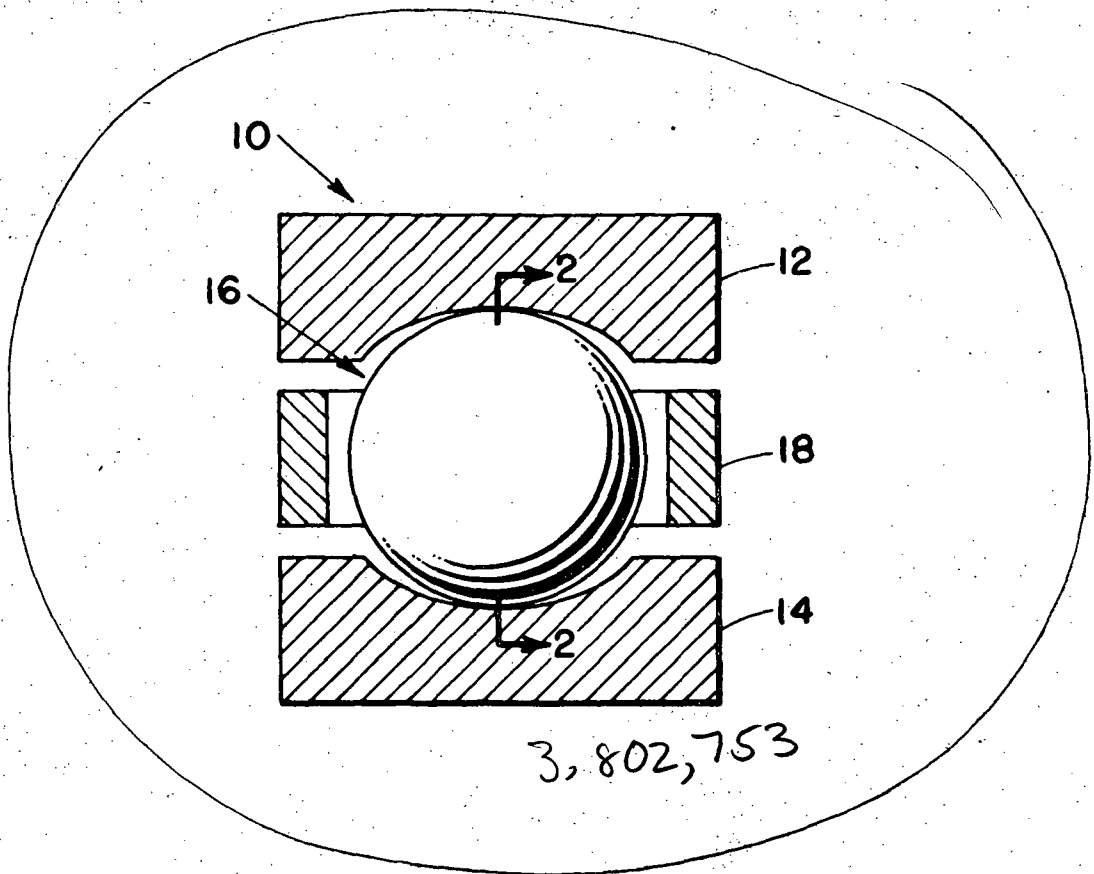
Assistant Examiner—Frank Susko

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[57] ABSTRACT

A low mass rolling element has a lightweight core with a hollow center. The core is plated to provide a hard surface.

6 Claims, 2 Drawing Figures



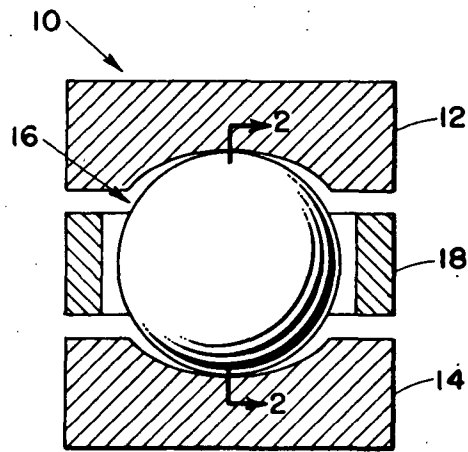


FIG. 1

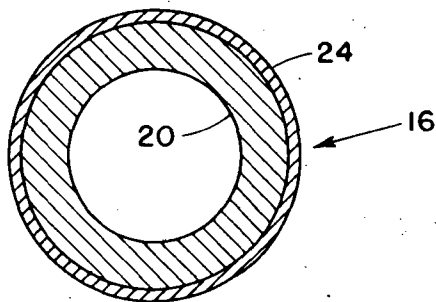


FIG. 2

# HOLLOW ROLLING ELEMENT BEARINGS

## RELATED APPLICATION

This application is a division of copending application Ser. No. 201,904 which was filed Nov. 24, 1971 U.S. Pat. No. 3,751,123.

## ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

## PRIOR ART

This invention is concerned with an improved bearing having low mass rolling elements. The invention is particularly directed to rolling elements having lightweight hollow cores that are plated.

When conventional rolling-element bearings are used at high rotative speeds centrifugal forces of the rolling elements on the outer races are detrimental to bearing life. Low mass rolling elements reduce this centrifugal force thereby increasing the life and reliability of high speed bearings.

Low mass rolling elements, such as hollow balls and rollers, are used in bearings on shafts which start and stop quickly. Less energy is required for acceleration and deceleration with hollow rolling elements because of their low inertia.

Low mass rolling elements can be fabricated of a material with a density significantly less than bearing steels. Other low mass rolling elements are hollow to reduce the mass. In either hollow rolling elements or those of low density material the fatigue strength must not be less than that of solid elements of high quality bearing steel. Rolling elements of relatively low density material have shown much lower fatigue strength than have conventional balls and rollers. Hollow balls of conventional bearing steels with significant mass reduction have shown either a weakness in the weld material or flexure fatigue of the wall.

## SUMMARY OF THE INVENTION

These problems have been solved by providing low mass rolling elements constructed in accordance with the present invention for improved bearings. Low mass rolling elements are produced by forming hollow cores of an inexpensive steel. The low mass hollow core is plated with iron and heat treated to form a hard surface.

## OBJECTS OF THE INVENTION

It is, therefore, an object of the present invention to provide low mass rolling elements for bearings having a high fatigue strength and high resistance to flexure fatigue.

Another object of the invention is to provide low mass rolling elements for a bearing whose fatigue strength is as good as or better than solid rolling elements of conventional materials.

A further object of the invention is to increase the life and reliability of high speed ball bearings by using low mass balls.

These and other objects of the invention will be apparent from the specification which follows and from

the drawing wherein like numerals are used throughout to identify like parts.

## DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical section view through a rolling element bearing having a rolling element constructed in accordance with the invention; and

FIG. 2 is an enlarged sectional view taken along the line 2—2 in FIG. 1.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing there is shown in FIG. 1 an improved rolling element bearing assembly 10 of the ball bearing type. The bearing assembly 10 comprises an outer race 12 spaced from the inner race 14. Rolling elements 16 in the form of balls roll between the outer race 12 and the inner race 14. The balls are properly spaced by a separator 18 or cage.

According to the present invention the rolling element 16 is made up of a hollow core 20 shown in FIG. 2. Both the cores 20 and 22 are covered by a plated surface material 24.

The hollow core 20 shown in FIG. 2 is made by forming a hollow sphere of inexpensive low carbon or medium carbon steel. This hollow sphere 20 is fabricated by welding together two hemispheres of the low carbon or medium carbon steel. This can be accomplished in accordance with the teachings of copending application Ser. No. 196,971 by Thomas Moore entitled "Production of Hollow Components for Rolling Element Bearings by Diffusion Welding" which was filed Nov. 9, 1971.

The hollow spherical core 20 is plated with pure iron. This is accomplished by electrolytic deposition, ion plating, or sputtering.

The plated cores are then heat treated by a case hardening process. Carburizing has been satisfactory. The plated cores are then ground and finished to the required tolerances.

Each rolling element 16 has a low mass and a hard homogenous surface with a relatively soft and ductile inner core. The hardness of the iron plating 24 is between Rockwell C 60 and 65. The thickness of the finished iron plated surface is preferably at least twice the depth of the maximum shear stress expected in the application. This thickness is on the order of 0.012 to 0.015 inch. The homogeneous iron 24 is inclusion free and can provide rolling-element fatigue strength equal to or better than conventional high quality bearing steels. The relatively soft ductile inner hollow core 20 eliminates the problem of flexure fatigue of the wall.

The races 12 and 14 are fabricated from ring shaped blanks of a high hardenability bearing steel, such as AISI M-50. The blanks are heat treated to a Rockwell C hardness of 58 or greater. The ring blanks are then ground to specified dimensions to form an inner race and an outer race.

Although a preferred embodiment of the invention has been described it will be appreciated that various modifications may be made without departing from the spirit of the invention or the scope of the subjoined claims. The bearing assembly 10 can be made to form an angular contact ball bearing to accommodate radial or thrust loads or to form deep groove ball bearings to take primarily radial loads.

What is claimed is:

1. An improved bearing comprising an inner race, an outer race spaced from said inner race, and a plurality of rolling elements positioned between said inner and outer races, each of said rolling elements consisting essentially of a hollow core having a low mass to reduce the centrifugal forces acting on said outer race and reduce the inertia of said rolling element, and a homogenous inclusion free iron plating on the outer surface of said core to provide fatigue strength, said plating having a thickness between about 0.012 inch and 0.015 inch.
2. A bearing as claimed in claim 1 wherein the hollow core is steel.

3. A bearing as claimed in claim 1 wherein the plating has a hardness between Rockwell C 60 and 65.

4. A bearing as claimed in claim 1 wherein the inner and outer races have a Rockwell C hardness of 58 or greater.

5. A low mass rolling element for a bearing consisting essentially of

a lightweight hollow core having a low mass, and an iron plating having a thickness between about 0.012 inch and 0.015 inch on said core to provide a hard surface, said iron plating having a Rockwell C hardness between 60 and 65.

6. A low mass rolling element as claimed in claim 5 wherein the hollow core is steel.

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